The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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"Luck" in Chemical Discovery

IT is an old and beloved story how, during research on dyestuffs, the Badische Co. desired to find a cheap method of making phthalic anhydride, and how that was achieved by a lucky accident befalling a German chemist, one Herr Sapper, who was heating naphthalene with sulphuric acid when his thermometer broke, releasing a small amount of mercury. This last proved to be the essential catalyst for accelerating the reaction and cheapening the production of phthalic anhydride so that the firm was enabled to undertake successfully the manufacture of new classes of dyestuffs. Amongst these was indigo, and the effect of the breaking of that thermometer was to extinguish within ten years the large-scale cultivation of the indigo plant in India, which had occupied over 1½ million acres. It is said that, owing to the elimination of their means of livelihood by this discovery, a million Hindu agricultural labourers, who had worked on the indigo plantations, starved to death. The discovery of the property of specific gravity, or perhaps more properly of the means by which it could be measured, occurred to Archimedes (if popular rumour is to be believed) by the accident of spilling his bath-water.

Two examples of this type of discovery are to be found in a technical communication (No. 39) recently issued by the Imperial Bureau of Soil Science. One of them is almost commonplace; the other is a real "accident," but both should be recorded for they have a moral. Both examples concern a serious orchard disease affecting apples in the U.S.A. known as "rosette," which caused much otherwise excellent land to be abandoned. In one of these areas iron sulphate was being tried as a fertiliser and was successful. Later experiments with pure ferrous sulphate gave a negative result. It happened that the original successful ferrous sulphate was of commercial quality and among the impurities contained therein was zinc sulphate. Further experiments showed that zinc sulphate was the effective agency in curing the disease in apple trees.

The second example is of the more truly "accidental" type and has been thus described by H. A. Gardner. Research on the "rosette" disease of pecan trees had been in progress since about 1902. "An ordinary galvanised water bucket provided the clue. This bucket was used during the autumn of 1931, when Messrs. Alben and Cole of the Department of Agriculture were experimenting with dips and sprays to control the rosetting of pecan trees. They were treating the trees with solutions of iron sulphate. Some of these solutions were placed in wood buckets, and trees treated with solutions from these buckets did not respond as readily as when they were treated with the same solutions contained in galvanised iron buckets. It was conjectured from this that some of the zinc in the galvanised coating might have been removed, and experiments were then began with zinc sulphate. This gave almost immediate success. They then experimented with zinc sulphate added to the soil, sprayed on the leaves, as hypodermic injections into the tree trunks, and by other methods. All were apparently successful."

There are here two examples of the same discovery being made by different workers in different places and each by methods that savour of the accidental. The only common factor is the presence of chemists on each occasion who were able to unlock the door to knowledge from the apparent failure, or to see the true explanation of apparent anomalies. Thus did Sir William Ramsay discover the rare inert gases.

There are, of course, untold instances of research in which a definite problem is set to be solved and can be solved by the application of known principles. Chemical engineering provides daily examples of this type of research. Measurements must be made, information obtained and when all is assembled the factors governing the problem can be set forth and the problem solved. That is not discovery in the full sense of the word. The type of discovery that so often seems accidental is one in which little or no hint of the solution can be known beforehand. It may be an attempt to find a new process for the manufacture of a chemical. It may be an attempt to explain the apparently inexplicable. The mind searches for guidance when, as in a flash, light comes from some chance observation, or some heedless comment of a bystander. All who are engaged in chemical research of this character must have experienced unexpected successes arising in this curious manner.

The great common factor on all these occasions is that someone shall be present whose mind is steeped in the problem and who shall have the training and imagination enabling him to visualise the truth that has been hidden in anomalous results and unexpected happenings. Such a man is worth a great deal to his firm. But events do not always work out so successfully as described in the instances just related. We recollect a research in which the desired result was obtained once, and once only; but, alas, we never discovered to what the happy result was due and that secret yet remains locked in Nature's bosom.

NOTES AND COMMENTS

The "C.A." in the Front Line

WE have not said much about ourselves lately. Frankly we have not had time to. Not only is there a war on, but London, our physical as well as our spiritual home, has, as all the world knows, been in the trough of the Blitzkrieg. Pictures have been published of damage to St. Paul's Cathedral, *The Times* office, and the Temple. All these national monuments are in our postal district. Nobody can doubt that we have been in the front line. For the best part of a week, for reasons which need not be specified in detail, we were obliged to produce this journal in an environment which would have seemed fantastic to any but the adaptable journalist. It was done at a moment's notice, and we could only pick up what lay nearest to our hands. But it is safe to say that none of our readers noticed the slightest difference in the succeeding issue, produced though it was under unprecedented conditions. Postal, telegraph and telephone services may falter and temporarily fail. It is a newspaper's business to carry on, and we have carried on. And we intend to carry on in London, which is not only the capital of the greatest Empire in the world, but is by far the most convenient centre from which to publish a national journal such as this. All sorts of weird adventures and strange vicissitudes may yet be in store for us, but nothing that has happened shakes our complete confidence in the victorious conclusion of the war, and in our ability to make our contribution to it without interruption in point of time or loss of quality in our effort.

Air Attack and Unemployment

AN American oil chemist, it is reported, has had to return from Germany to his native country because all the twelve plants of the company which had employed him for the past fourteen years have been put out of action by the R.A.F. This is but one of the stories concerning the effect of the British air attack upon German industrial resources which have lately filtered into this country from neutral sources. And though it would be idle to deny that the German bombing attacks on Britain have been entirely without effect on the chemical industry, nothing comparable to that can be recorded. Delays and inconvenience have certainly had to be faced in this country, and there has been the loss of some irreplaceable lives to lament, and the destruction of valuable plant to repair. But very few chemists can complain that they have been thrown permanently out of employment because of the *Luftwaffe*. Perhaps the main reason for this is that our statesmen never fostered the delusion here, as Goering did among the Germans, that the country was invulnerable to air attack; and precautions were consequently taken. What these precautions were, it is obviously inexpedient to specify. But they were sufficient at any rate to allow the British chemical and chemical engineering industries to carry on their essential services in the face of air attack. Mr. Bevin tells us we must surpass the production of our enemies in the next six months; in the chemical industries, at any rate, the courage of the workers in sticking to their task in the face of attack, and the ingenuity of the managements in overcoming the difficulties incidental to total war, should enable his prescription to be carried out triumphantly.

Windows in War-Time

INVESTIGATIONS into war-time problems arising from the use of glass in buildings have been carried out by the Research Department of Messrs. Pilkington Brothers, Ltd., under the direction of Dr. H. Moore, F.Inst.P. For some time now this firm has been conducting an experimental investigation towards the solution of these problems. A brief account of this work, and the conclusions deduced from it, has just appeared in the October issue of the *Journal of Scientific Instruments*. Among the " black-out " difficulties dealt with is the cracking of black-painted glass due to greatly increased absorption of radiation and consequent development of temperature differences in the sheet sufficient to cause strains beyond the elastic limit. Fairly exhaustive tests on methods of preventing the fracture of glass due to blast, confirm that it is virtually impossible to safeguard glass except by completely enclosing it. Only massive forms of reinforcing systems, such as protective grilles, can be of any value in reducing risk of fracture of the glass itself. Dr. Moore discusses the many different treatments that have been suggested to prevent fragments of glass from flying, such as the fixing of fabric netting and other substances to the glass by various adhesives and by suitable freely hanging screens covering the window on the inside. Some interesting photographs show the type of fracture which occurs to windows treated in various ways.

Greek Chromite

ONE effect of the unprovoked attack on Greece by the Axis Powers will be the cessation of the export of chromium ore, in the shape of chromite, from Greece to Germany. Published figures show that the quantity of chromite exported from Greece to Germany had been rising very rapidly; in 1936 the total was 5326 metric tons, in 1937 11,245, in 1938 18,160, and in 1939 the peak figure of 22,278 metric tons was reached. A recent issue of *Mineral Trade Notes* contains some particulars of the chromite produced in Greece, of which about 80 per cent. is " refractory " ore containing 37 to 40 per cent. Cr_2O_3 and less than 6 per cent. silica; the remaining 20 per cent. contains 46 to 50 per cent. Cr_2O_3 and is suitable for ferro-chrome manufacture. Owing to competition with Yugoslav and Turkish ores, the Greek mines have hitherto been working only to about half their potential capacity. A large proportion of the 1940 production of chromite has been assigned to British interests, and options have been taken out on the 1941 output of most of the principal mines. In 1939 exports to the U.K. amounted to 11,255 tons as compared with only 1870 in 1938. Chromite deposits are located in widely separated parts of Greece, mainly in the north and north-east, but only one group of small mines, near Kozani, is situated in the present war-zone.

FERRO-NICKEL IN OPEN-HEARTH FURNACES

A method for obtaining ferro-nickel in open hearth furnaces has been elaborated by Mr. I. Lukavchenko, an engineer at the Soviet Institute of Research in Ferrous Metals in the Urals. After much experiment in the laboratory and then on a semi-industrial scale at the Nizhne-Saldinsk Metallurgical Works, Mr. Lukavchenko obtained in an open hearth furnace an alloy with a nickel content up to 40 per cent., which is said to be suitable for the production of nickel steel. The raw material used for the metal was nickel ores, fluxes and small coke waste. By using this method it is possible to organise the production of nickel at any metallurgical works having open hearth furnaces without additional capital outlay.

SYNTHETIC RUBBER IN THE CHEMICAL INDUSTRIES

Some Advantageous Uses for Neoprene

by A. E. WILLIAMS, F.C.S.

CHEMISTS outside the rubber industry have followed the development of synthetic rubber, through the technical press, with much interest. It is not their fault if they have displayed less interest as to what happens to the rubber from the latex stage, because comparatively little has been published. As is well known, there are now two main types of synthetic rubber produced commercially, those of the Buna class—made chiefly in Germany, Russia and the U.S.A.—and neoprene products, originated by the Du Pont de Nemours Company in the U.S.A., and now manufactured in this country by Imperial Chemical Industries, Ltd.

While the two synthetic rubbers have much in common they differ essentially in two respects. Rubbers of the Buna class—that is those produced from butadiene—need sulphur as a vulcanising agent; whereas neoprene—from chloroprene—can be vulcanised, if necessary, without sulphur. Buna rubber, in common with natural rubber, will produce a hard ebonite or vulcanite by using an excess of sulphur; but when neoprene is similarly treated a hard product does not result. In other directions the compounding and treatment of the two raw rubbers has much in common, and as neoprene compounds only are produced in Great Britain it is appropriate to deal with this class. The name "neoprene" is non-proprietary and may be applied by any rubber compounder or moulder to his goods containing neoprene manufactured by I.C.I., Ltd. This company does not manufacture for sale any finished neoprene goods, but supplies the numerous rubber works with what corresponds broadly to the natural rubber latex—neoprene—from which such works produce the finished articles.

Unvulcanised uncompounded neoprene slowly toughens if kept for prolonged periods in storage without being used, especially in a warm atmosphere; so that in the rubber works it is stored in a cool place and not more than a month's supply is kept in stock. It may be vulcanised by heat alone, but in practice the necessary physical properties desired in the finished article are obtained by vulcanising after incorporating with materials such as wood rosin, sulphur and specific oxides. Magnesia may be regarded as the chief of these vulcanising agents, and when used with zinc oxide or litharge it serves to neutralise any residual hydrochloric acid used in producing neoprene; to obviate scorching in processing; and to increase the tensile strength of the vulcanised material. Zinc oxide may be regarded as an accelerator in the vulcanising process, and magnesia functions to retard its action. It has been found that a mix containing zinc oxide and no magnesia becomes prematurely vulcanised, during mixing, even at a temperature as low as 50° C., so rendering further processing impossible.

Effect of Compounding Agents

Litharge, which is a mild accelerator, produces, in the absence of the other metallic oxides, compounds of lower tensile strength than the zinc oxide-magnesia compounds. But if litharge is used with magnesia it produces products having physical properties equal to zinc oxide-magnesia compounds, and the rate of cure and the hazard of scorching are lessened. Wood rosin, or a similar material, is an important constituent in compounding neoprene. Used alone it is not a vulcanising agent, but it facilitates the reactions of sulphur and the metallic oxides. The effect of wood rosin is considered to be due to its abietic acid, and the commercial grade of this acid may be used instead of the rosin when necessary. Sulphur tends to accelerate the vulcanisation of compounds containing zinc oxide-magnesia or litharge-magnesia, and it increases the tensile strength and toughness of such compounds. But sulphur has a disadvantage in that it increases the tendency to scorching; with some mixes, however, this tendency is reduced by increasing the proportion of wood rosin. In common with natural rubber compounds, excess amounts of sulphur will cause blooming on the surface of the finished goods.

Another important ingredient of a synthetic rubber compound is an anti-oxidant. The function of this is to improve the ageing properties and also the resistance to heat. A commonly used anti-oxidant is phenyl-β-naphthyl-amine, officially known as Neozone D. The table below gives the composition of eight different neoprene compounds, and, when cured for 40 minutes at a temperature of 153° C. in the laboratories of I.C.I., Ltd., the stress-strain curves in Fig. 1 show the effect of these varying mixtures, especially of sulphur.

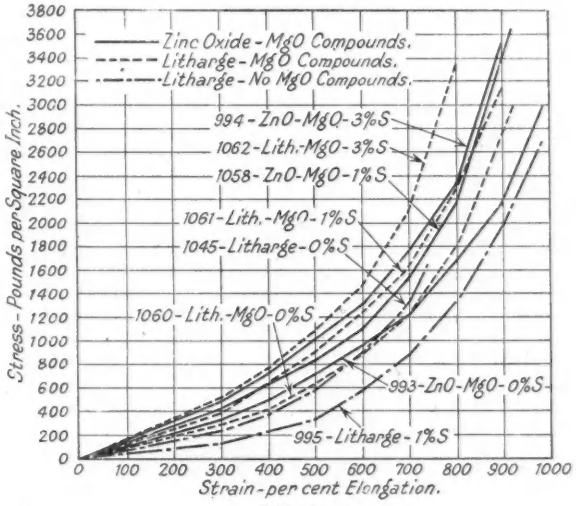

Fig. 1.

Compound No.	993	1058	994	1060	1061	1062	1045	995
	Parts by weight.							
Neoprene	100	100	100	100	100	100	100	100
Neozone D	2	2	2	2	2	2	2	2
Wood Rosin	5	5	5	3	5	5	5	5
Magnesia	10	10	10	10	10	10	—	—
Zinc Oxide	10	10	10	—	—	—	—	—
Litharge	—	—	—	20	20	20	20	20
Sulphur	—	1	3	—	1	3	—	1

Results of physical tests on compounds No. 993, 1058 and 994 show the increase in rate of cure and the higher modulus secured by the addition of sulphur to a zinc oxide—magnesia compound. Note that one per cent. of sulphur has a marked effect, and when this is increased to 3 per cent. the effect is less. No. 994 shows the shortening of the range of cure with 3 per cent. of sulphur. The compounds 1060, 1061 and 1062 have a smaller proportion of rosin than normal, but they illustrate the action of sulphur, and that it has the same effect on litharge-magnesia as on zinc oxide-magnesia compounds. The necessity for using sulphur in litharge-no magnesia compounds is obvious from a comparison of compounds 1045 and 995, the former being badly undercured, while 995 contains sufficient sulphur for proper curing, but has comparatively poor physical properties owing to lack of rosin. To cover the art of compounding neoprene fully would require too much space, but sufficient has been

written to indicate the different physical properties produced in the vulcanised product by varying the compounding ingredients.

Most of the pigments and fillers that are used in natural rubber may also be used in neoprene, and, in general, they have the same effects. There are, however, some differences. For example, the addition of gas black to natural rubber greatly increases the tensile strength, but with neoprene the black makes no marked difference in this direction. Different grades of carbon black are used to give different properties to the finished material, such as high resistance to abrasion, oil-absorption, etc. For compounds which have to be light in colour glue is found to be a good reinforcing agent and this also increases the resistance to oil. Glue may be used in amounts up to about 18 per cent. of the weight of neoprene. Clay is another powerful reinforcing agent for neoprene, but it imparts some abnormal properties to the compound. It also induces poor oil-resistance, though giving a relatively hard stock. Zinc oxide may be used both as a vulcanising agent and as a reinforcing material, and when used as the latter its effect is much the same as clay. It is, however, not generally recommended as a reinforcing agent.

A filling material is used primarily to lower the cost of the compound, and, as in many other branches of industry, the ideal filler is that which may be used in the largest proportion without detracting from the normal characteristics of the compound. Some grades of soft carbon blacks are used as fillers, and although cheaper fillers are available than blacks, the latter permit a higher proportion to be used; thus, actually, they are less costly than a filler at, say, half the price, because the latter could not be incorporated to the same extent. A soft carbon black filler maintains the desirable characteristics in the neoprene to the greatest extent, and because of this a neoprene stock which has to be light in colour—and therefore cannot be loaded with black—does not represent the same money value as a black stock. Alternative filling materials include whiting, barytes, asbestine, ground slate, etc. Of these whiting generally gives the best results, but none is as good as a soft grade of carbon black, and this is used whenever permissible.

In the chemical industries the problem of finding satisfactory material for transmission and conveyor belts is no easy matter for, owing to corrosive influences, a belt that would last for years in the average mechanical workshop would, under the same load, become useless after a few months in a chemical factory. A manufacturer of chemicals nowadays takes care to see that his plant is constructed of the appropriate materials to withstand the corrosion of his particular products, but generally little thought is given to the correct belting material for driving such plant, no doubt because belts are relatively cheap in relation to the cost of the plant. A point often overlooked, however, is that constant belt trouble leads to loss of processing time, while belts are being repaired or replaced, and sometimes to irretrievable spoiling of products in process through belt failure at a critical moment. Until the coming of synthetic rubber the average chemical factory was unable to make use of the advantages of rubber in belting, such as improved grip on pulleys and greatly reduced response to external influences on belt length, because of the poor resistant properties of the rubber.

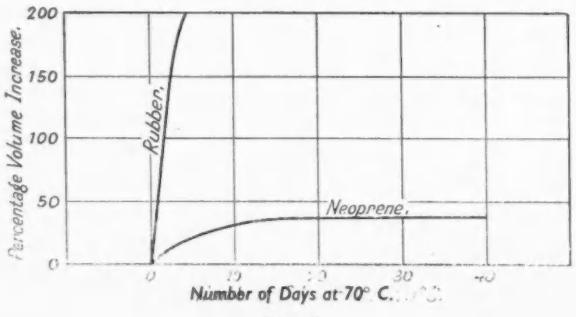

Fig. 2.

With a leather or woven fabric belt considerable belt-slip is invariably present, and usually such belts need to be reduced in length after a few days' running. When properly compounded a synthetic rubber belt—generally used in the form of a rubberised fabric—gives a much longer life than a natural rubber product. This is because the synthetic substance is more resistant to heat, abrasion, oils, and general chemical corrosion. A glance at the following table shows the difference in behaviour of neoprene and natural rubber when immersed in boiling water, acids and oil.

Immersion medium.	Temperature.	Period of immersion required to perish the sample. Rubber.	Neoprene.
Water	100° C.	28 days	182 days
HCl (conc.)	70° C.	3 days	182 days
H_2SO_4 (50%)	70° C.	3 days	56 days
Mineral Oil	70° C.	25 days	over 400 days

Tests on Belting

When synthetic rubber was still in the experimental stage some neoprene belts were made up for testing under working conditions. In one instance a neoprene belt was put on to drive a stirrer in an atmosphere of nitric and sulphuric acid fumes, transmitting 2 h.p. at 200 r.p.m. The belt ran continuously for 24 hours a day, giving a useful life of 20 months under these severe conditions. A similar belt of natural rubber, under the same working conditions, had a life of 1.5 months. In another case, in which sulphuric, acetic and formic acid fumes were constantly present, a neoprene belt, running continually at a temperature of 50° C. and transmitting 5 h.p. at 226 r.p.m. to a stirrer, was still good after 20 months' service. In this instance no comparable data were available for the life of a rubber belt. At the present time, since improvements have been made both in neoprene itself and in compounding it, similar belts have a still longer life.

Conveyor belts, both metal and non-metal, are much in evidence in the modern chemical factory. Frequently, metal belts are unsuitable, from the corrosion viewpoint, or possibly because of risk of damage to the goods conveyed. In these circumstances a flexible belt with soft resilience is required, and both rubberised fabric and leather belts cover the need to a certain extent; but when unfavourable conditions are present the synthetic rubber belt has the advantage. For handling hot or oily materials neoprene conveyor belts have been found very serviceable, and in one practical works test, in which the belt had to carry hot asbestos fibre, a neoprene belt gave a life six times as long as a rubber belt previously used. In another works, in which hot lime was conveyed, a rubber belt lasted six to eight months, while a neoprene belt was still good after 17 months' constant service. In oil-seed crushing mills synthetic rubber belts are a paying proposition when handling either the hot oily seeds or the hot extracted meal, and the same applies to a great variety of chemical products.

The main reason for the rapidly increasing use of synthetic rubber is, however, its high resistance to oils. Natural rubber, on the other hand, quickly perishes if in contact with oils. Both natural and synthetic rubber swell when immersed in oil, but the swelling of the synthetic material is usually much less than that of rubber. The fundamental difference between the two materials is, however, that while synthetic rubber to a large extent maintains its elasticity, resilience, flexibility and tensile strength, the natural product largely loses these characteristics and so becomes useless. Some idea of the vast difference in degree of swelling of the two rubbers can be gained from a perusal of the two graphs in Fig. 2. This represents the result of exhaustive tests made in the laboratories of I.C.I., Ltd., and illustrates the behaviour of neoprene and rubber, compounded on an equivalent basis, when immersed in a light mineral oil at a temperature of 70° C., the samples being of the same size and shape. The neoprene swells steadily until after about 20 days' immersion no further swelling is noticeable, this representing about a 40 per cent. increase in size. Natural rubber, however,

increases rapidly in volume, to about 200 per cent. in under five days, after which its normal physical characteristics completely disappeared. The degree of swelling of both neoprene and rubber is governed chiefly by the compounding ingredients used, their properties, and methods of processing, and it is possible to achieve a lesser degree of swelling for both products than that shown in the graphs. But neoprene retains its rubbery properties better than rubber when the two are, specially compounded for oil-resistance.

Non-Inflammability

An important difference between natural rubber and neoprene is that the former readily burns, while the latter, when correctly compounded, is practically incombustible. This fire-resisting property of neoprene has led to its use in the manufacture of rubber flooring and of electric cable, both articles of widespread use in commercial buildings and factories, which have been the means of quickly extending a conflagration. It has been a common sight, in factory fires, to see flames spreading along the rubber-covered wiring well in advance of the general blaze. Several firms in the Cable Makers' Association now produce neoprene-covered cables. Neoprene forms in each case the outer covering of the cable, other insulating materials being used next to the conductor. There are two reasons for not using neoprene entirely as a conductor covering. Firstly, it is much dearer than rubber or the other usual insulators, and secondly, the electrical properties of neoprene do not represent the ideal form of electrical insulator; so that it is used in the form of a stout sheath to protect other insulation underneath. Alternative forms of wiring in chemical factories include rubber-covered cables laid in steel conduit tubing and lead-covered cables. Both of these are excellent systems where the corrosion problem does not exist, but where this is present conduit tubes often cause trouble. The outside of the tubing may be protected by special paints, but corrosion invariably occurs inside, through the drawing in of vapours, and these remain within the tubing to attack, unseen, the insulation of the cable. Lead covering is also vulnerable to various types of vapour, although the disintegration of such covering can usually be detected before it has gone too far. The neoprene-covered cable, being non-rigid, is also useful where much vibration is present, as in the supply of current to motors or lamps mounted on stirrers, etc.

A special technique has been developed by which neoprene can be securely bonded to either wood or metal. This has enabled tanks and other vessels for use in chemical works to be lined with neoprene, in which sphere it is said to give more satisfactory service than is obtained with natural rubber. It is also used in making hose to convey oils and petrol, for diaphragms and washers, valve linings, and for chemical workers' gloves and aprons. Because of its low permeability —its hydrogen permeability is only one-third that of rubber —it is used in gas-sampling apparatus and for the lining of balloons.

Flexible Ebonite

Rubbers of the Buna class, in one respect, simulate natural rubber more closely than neoprene, because the butadiene products can, in the presence of an excess of sulphur, be vulcanised to hard rubber, *i.e.*, vulcanite or ebonite. These hard Buna rubbers have a softening point nearly twice as high as natural rubber products similarly compounded, a great advantage in the many applications where ebonite is required to withstand relatively high temperatures. For example, a typical natural ebonite will soften at about 70° C., whereas a butadiene ebonite may not soften below 130° C. On the contrary a neoprene product cannot be vulcanised to a hard rubber, no matter what proportion of sulphur is used, and this property has been put to commercial use (E.P. 428,052) in producing what is known as "flexible ebonite." This material is made by mixing natural rubber and neoprene and compounding with an excess of sulphur, which, in the case of natural rubber alone, would give a normal hard ebonite on vulcanisation. The vulcanised mixture, however, is a strong but flexible material and it is applied in various ways in the chemical industries. Complete pipe-lines are made from it, also small apparatus such as acid buckets. It is useful for insertion at certain points in metal pipe-line systems where much vibration is present, and when so applied it acts as a flexible joint in the line, preventing leakage at joints through vibration. What the engineer describes as "awkward" bits of apparatus, such as elbows, U- and Y-pieces, etc., can readily be produced in flexible ebonite instead of metal. It is also used in lining the baskets of centrifugal machines when the product handled is of a corrosive nature. The general resistant properties of flexible ebonite are superior to ordinary ebonite and to neoprene itself, and because of its good electrical qualities it is used as an insulator where strong corrosive influences are present. For example, in the plating industry it is used for the frames on which the articles to be plated are carried, and these frames must carry no current nor be corroded by the plating solutions.

Chemical Matters in Parliament

Supplies of Fertilisers

IN the House of Commons last week, Sir L. Lyle asked the Under-Secretary of State for the Colonies whether he would cause the present prohibition on the importation of Canadian and American fertilisers into Jamaica to be removed, in view of the fact that such fertilisers were essential to the production of sugar and that it was not possible to obtain supplies in this country.

Mr. George Hall, in reply, said that the question of supplies of fertilisers for the sugar industry had been carefully considered in consultation with the Governors of the Colonies concerned, and, having regard to the actual supply position in the Colonies and the paramount necessity for conserving dollar resources, it had not been found possible to authorise the immediate expenditure of dollars on such fertilisers. The position would, however, be reviewed at a later date when present supplies were nearing exhaustion.

Ersatz in France

Oil and Soap from Grape Pips

SPECIAL centres are to be set up in unoccupied France for the distribution of grape pips to be made into oil and soap. The importance of this new industry was recently outlined by Monsieur Moiset, a Midi chemist who is organising the construction of the necessary plant. He pointed out that France and Algeria could supply ten million kilos of oil, half of which would be refined for consumption and half turned into soap. Co-operative distilleries were now being installed with the necessary machinery.

The chief problem, it appears, is separating the pips from the skins. The best machinery for this work is Italian, and the French Government is now negotiating for the purchase of numerous machines. Delivery, however, is expected to be slow owing to the war. In order to regulate the distribution of the pips the Ministry of Agriculture is to open regional warehouses which will buy from the wine growers at a fixed price, and sell the product to recognised firms.

It is also interesting to note that the French Government is preparing the people for ersatz feeding. Recently the *Frankfürter Zeitung* brought out a special supplement describing synthetic foods and products. These included synthetic fats and even meat pills produced by pulverisation. Articles appearing in the French Press stress that chemicals must play their part in feeding the nation at a time of serious shortage. But the writer quickly adds that the Government will not pursue the manufacture of ersatz to the same extent as the Germans and the Italians.

Personal Notes

MR. CYRIL S. DINGLEY has joined the board of British Industrial Plastics, Ltd.

MR. HUGH BEAVER, M.Inst.C.E., M.Inst. Chem.E., has been appointed by the Minister of Works and Buildings to be Priority Officer and Controller of Building Materials.

MR. W. H. GRIEVE has been appointed chairman of Light-alloys, Ltd., on the resignation of Captain Oliver Lyttelton, now President of the Board of Trade.

DR. A. J. V. UNDERWOOD, F.I.C., M.I. Chem.E., has been elected a Member of Council of the Institution of Chemical Engineers.

MR. H. W. G. HIGNETT, B.Sc., A.I.C., has joined the staff of the Research and Development Department of the Mond Nickel Co., Ltd. He will devote his time principally to matters involving welding.

At Holy Trinity, Blackpool, last Saturday, was celebrated the marriage of MR. T. D. STEVENSON, B.Sc. and MISS JOAN M. PATTERSON. Mr. Stevenson holds an important position on the chemical staff of I.C.I., Ltd., at Northwich.

For the tenth year in succession DR. ROBERT ROBERTSON has been re-elected chairman of the governors of the Royal Technical College, Glasgow. As a war-time measure it has been decided to appoint a vice-president, DR. J. W. FRENCH, of Messrs. Barr and Stroud, Ltd., scientific instrument makers, Glasgow.

OBITUARY

DR. J. E. F. DE KOK, president of the Royal Dutch Petroleum Company, died on Monday at The Hague, aged 58.

MR. AUSTIN MILLS, who was employed for nearly 50 years at the Torwood Foundry of Messrs. Jones and Campbell, has died at Larbert. He was 74 years of age.

MR. LESLIE FRAZER WHITEHEAD, who died last week at his home in Leeds, for some years was a lecturer on edible fats and oils at the Central Technical College. Later, he was engaged in research on the refining and hydrogenation of edible oils at Selby, and 14 years ago became chief chemist to a Leeds firm, finally being elected to the Board.

MR. ARTHUR HUMPHREYS, who died last week at York, aged 81, was managing director and secretary of Bleasdale, Ltd., wholesale chemists, from the formation of the company until 1924, when he was elected chairman, a post that he retained until his death. Mr. Humphreys was president of the York Chamber of Commerce in 1904 and for many years took an active part in the city's social and commercial activities.

MR. JAMES DAVID HOWARD, director of Howards and Sons, Ltd., the well-known chemical manufacturers, of Ilford, Essex, died recently, aged 28, as the result of an accident due to enemy action. He was the son of Mr. Bernard F. Howard, who is also on the board of Howards and Sons. Mr. J. D. Howard, who had been managing director of the company for the last few years, was the youngest director in the firm. He was educated at Marlborough and Clare College, Cambridge, and had travelled widely in the interest of the firm.

SIR HERBERT WRIGHT, who died last Monday in his home at Chalfont St. Giles, Bucks, aged 66, was well known for his work on the chemistry of tropical agriculture. Since 1900 he had been interested in the scientific side of the rubber industry and latterly he became a director of some thirty companies and trusts connected therewith. In 1932 he was elected chairman of the Rubber Growers' Association and he was for many years chairman of the Finance Committee of the Royal College of Science. In 1907-17 he edited the *India Rubber Journal*, and his writings included volumes on the chemistry, etc., of *Hevea brasiliensis* and *Theobroma cacao*.

British Chemical Prices

Market Reports

TRADE in most sections of the general chemical market has been on a moderate scale during the past week and considering the difficult conditions prevailing the volume of inquiry for new business has been decidedly good. At the consuming end deliveries under existing commitments are well up to schedule and a fair number of contract renewals have been made. An active market exists for the majority of the soda compounds and there is also a steady flow of inquiry for borax, formaldehyde, acetone and lead oxides. Supplies of oxalic, citric and tartaric acids are none too plentiful and most of the potash products continue to be similarly placed. Trade in the coal tar section is comparatively quiet though rather more interest is apparent than during recent weeks. Dealers report a better inquiry for cresylic acid and prices throughout are held at recent levels.

MANCHESTER.—Both home and export business in heavy chemical products on the Manchester market during the past week has continued on a moderate scale, and so far as the domestic market is concerned a satisfactory feature has been the steady call for contract deliveries for most of the chief using trades in the district. Values, as before, are steady to firm pretty well throughout the range. Among the by-products pyridine has again given way slightly, but in most other directions the quotations have been maintained and, in the light materials especially, a fair volume of business has been reported.

GLASGOW.—The slight improvement in the Scottish heavy chemical trade has been maintained with prices keeping firm. Certain commodities, such as sodium sulphoricinoleate, etc., are extremely scarce. Business on the Glasgow market is rather difficult, and prompt delivery cannot be guaranteed owing to the delay in transport arrangements from the South. The export trade is again quiet.

Price Changes

Carbolic Acid.—Crystals, 9½d. to 10¾d. per lb.; crude 60's, 3s. 6d. to 4s., according to specification. MANCHESTER: Crystals, 10½d. per lb., d/d; crude, 3s. 8d. to 4s. naked at works.
Pyridine.—MANCHESTER: 15s. 6d. to 18s. 6d. per gal.

Purchase Tax Arrangement

Tax-Free Purchases by Registered Persons

THE Commissioners of Customs and Excise give notice that they are prepared to accept an arrangement whereby registered persons habitually buying goods as stock or materials may furnish a general statement to the seller covering all their purchases during a stated period not exceeding six months. This arrangement may be adopted as an alternative to the requirement of a particular statement on each order described in paragraph 6 of Notice No. 77. A letter in the following terms addressed to each supplier concerned will be regarded as satisfactory for this purpose provided it is signed by the proprietor of the business if an individual, by a partner in the case of a private firm and by a director or the secretary in the case of a limited company.

Dear Sirs,

PURCHASE TAX

As required by Section 24 (1) of the Finance (No. 2) Act, 1940, we hereby certify that we are the holders of Purchase Tax Registration Certificate No. .....

We authorise and request you to invoice to us any goods liable to purchase tax which are supplied to our account within six months of the date of this letter without the addition of the amount of such tax, save where we notify you to the contrary in respect of any particular transaction. We intend to use all goods so supplied as stock for sale or as materials in manufacture. In the event of their being appropriated to retail trade or to other taxable purposes, it is understood that we will be accountable to the Crown for payment of tax thereon.

Yours faithfully,

(Sd.) .....

Date.....

This letter must be retained by the supplier for production on demand to the proper officer of Customs and Excise. Unless the transaction is covered by a specific order in the terms of paragraph 6 of Notice No. 77 or a general letter in the above terms, the seller is legally accountable for tax on the purchase.

Metallurgical Section

November 2, 1940

ESTIMATION OF HYDROGEN IN STEEL, I*

Development of the Vacuum-Heating Method

SINCE about the beginning of the present century, the ever-growing and more exacting requirements of the engineer have caused the metallurgist to devote more and more of his energy to improving the quality of his product. An enormous amount of fundamental research has been conducted into the correlation of the physical properties of metals (especially steel) with their precise mode of production, their chemical composition and their constitution. The discovery that very small additions of other elements can radically affect the properties of metals has added impetus to the development of micro-chemistry, but there are certain non-metallic elements which, whilst influencing the properties of metals, even when present in minute amounts, call for a specialised technique, more physical than chemical, since they enter or leave the metal in the form of gas.

Foremost among the gases which influence the properties of metals is hydrogen, and the object of this paper is to describe an apparatus which has been developed at the Brown-Firth Research Laboratories, Sheffield, for the accurate estimation of hydrogen in metals.

Much of the earlier work upon the gases present in metals was hampered by the fact that the necessary vacuum equipment was not then available, and whilst it is interesting and instructive to examine the writings of the earlier workers in this field, their analytical results and their consequent conclusions must be viewed in relation to the times in which the experiments were made. Following the work of Graham, Parry, Dumas, and Belloc, towards the close of the 19th century, Baker in 1909 made a careful examination of the gas given off from steel, using a method of steadily heating and cooling a steel sample and measuring the quantity and composition of the gas in relation to the temperature. He observed that at 690° C. an arrest (Ar_{123}) in the temperature was accompanied by a big evolution of carbon monoxide, whilst hydrogen reached its maximum rate of evolution at a somewhat lower temperature. In 1918 the Faraday Society held a general discussion upon the "Occlusion of Gases by Metals," which has since been published, and to which reference should be made for a summary of the various views held at that time.

Gas-Metal Affinities

The more recent work which has been done upon the hydrogen content of metals has, for the most part, utilised modern high-vacuum technique in the light of the theoretical advances which have been made. The consequence is that, as usual, our knowledge is both more complete and more complex. The mechanism whereby hydrogen is taken up by, or liberated from, a metal involves the processes of adsorption, solution and diffusion. It is to Langmuir that we owe the concept of a monomolecular layer of physically adsorbed gas. More recently the work of Roberts on the hydrogen-tungsten system and the work of Mann and Newell on the hydrogen-platinum and deuterium-platinum systems indicate that where some chemical affinity exists between the gas and the metal, then at normal temperatures a layer of gas is chemisorbed even at very low gas pressures.

The method of examining the metal surface in these experiments consisted of a measurement of the accommodation coefficient of neon or helium upon the surface. The importance of this to our considerations here is that since adsorption is a necessary preliminary to the diffusion and solution of the gas in the metal, the rate of removal of the gas from the metal will be influenced by (if not primarily dependent upon) the rate of the desorption processes. Since an adsorbed layer of gas can be quite stable upon a metal surface even in quite low gas pressures, it seems likely that in much of the work which has been done upon the removal of gas from metal, the long period of time found necessary for complete removal is due to the fact that the extraction pressure has not been low enough, so that the diffusion process has been hindered by the adsorbed layer. In the apparatus to be described a high vacuum is maintained by a mercury-vapour pump in continuous operation, and it is suggested that this may account for the relatively short period of time found necessary for complete extraction of the hydrogen.

The Adsorption Process

At temperatures at which the diffusion of hydrogen through metals can be measured, adsorption is of the activated type, and since thermo-chemical data for activated adsorption indicate dissociation of the diatomic hydrogen molecules, it is not surprising that the rate of diffusion is proportional to the square root of the gas pressure. However, at low gas pressures the rate of diffusion of hydrogen deviates from the square-root relationship and approximates more to a proportionality to the pressure. Since these measurements of diffusion involve the gas pressure external to the metal surface, the process of adsorption may influence them, so that it is quite possible that at low gas pressures the condition of the adsorbed gas may control the passage of gas through the metal. As regards the effect of temperature upon the rate of diffusion of hydrogen through metals, both experiment and theory give an exponential relationship, so that for the elimination of the gas from the metal it should only be necessary to exceed a certain temperature, and then the rate of elimination should increase rapidly with rise in temperature. This was found to be so for steel.

The solubilities of hydrogen in metals, examined carefully by many workers, are of interest to the present work as showing the likely quantities of gas which one would expect to find in the metals examined. It is of particular interest to note that the quantities of hydrogen found in steel are of the order of the solubility in iron up to temperatures approaching the melting point, and that the usual amount observed present corresponds to saturation at about 600° C., *i.e.*, to the temperature at which diffusion is beginning to slow up.

The present-day method of estimating the hydrogen content of metals is by melting *in vacuo*, and the apparatus in use in the Brown-Firth laboratories for this purpose has been described by the author in a Special Report of the Iron and Steel Institute. The work of the Oxygen Sub-Committee of the Institute having shown decisively that the effect of hot-working upon steel was to reduce the hydrogen content, Sloman determined the gas given off from several steel samples when heated *in vacuo* to a temperature of 650-700° C. His results show that after a period of heating of up to 2 hrs. gas ceased to be evolved, and that the gas was hydrogen corresponding in amount to that obtained by vacuum

* Adapted from a paper by Dr. W. C. Newell, of the Brown-Firth Laboratories, Sheffield, presented at the summer meeting of the Iron and Steel Institute, by courtesy of whom publication is here permitted.

fusion. These conclusions have been substantially confirmed and amplified by the present author, and the apparatus described has been designed and constructed to determine the hydrogen content of a dozen or more metal samples consecutively with a minimum of elaborate apparatus, and using this vacuum-heating method.

Since vacuum-fusion is the method generally accepted as reliable, and has for a long while been employed with confidence, a careful comparison with results obtained by this method has been kept throughout the investigation; the same-sized samples were used throughout (½ in. cylinders, ½ in. long). The possible error due to the " blank " in the vacuum-fusion apparatus was higher than was desired (sometimes amounting to 0.00005 per cent. of hydrogen on the metal sample). However, differences between the results by the two methods were for a while greater than this, even when the vacuum-heating method was operating under what were found to be the optimum conditions. The reason for this was not due to error in either method, but rather to segregation of the hydrogen in different parts of the metal, or else to the loss of hydrogen resulting from the sample getting too hot during machining. Samples which had a normal hydrogen content were found to give a somewhat lower value if during machining the piece became too hot to handle, or still more so if there was any temper-colouring produced upon the surface. Small steel castings were found to vary considerably in their hydrogen content at different parts, and much of our earlier perplexities were connected with this fact.

From a comparison of the results by the two methods for a number of metal samples there appears to be a tendency for the vacuum-fusion method to give slightly higher results than the vacuum-heating method. The reason for this appeared to be that the heating treatment had not extracted all the hydrogen, but the fact that several samples on vacuum fusion subsequent to vacuum heating gave no further evolution of hydrogen discredits this view. The accuracy of the heating method is ten times that of the fusion method. The temperature of operation for the heating method was 600° C., excepting for aluminium alloy samples, which were found not to give off their hydrogen until they were actually molten. These samples were inserted in small slip-cast alundum thimbles, in which they were melted in the furnace at about 700° C., cooled out of the furnace and when solid again manipulated in their thimbles as solid metal samples.

The rôle of hydrogen as a possibly deleterious constituent of metals is well recognised, and the apparatus employed not only has its applications in this direction, but also for the fundamental study of gas-metal equilibria, and the solution and diffusion of hydrogen in alloys.

(*To be continued.*)

Tantalum Minerals

Important Discovery in Uganda

REVIEWING local reports of tantalum minerals in Uganda, the current issue of the *Bulletin of the Imperial Institute* notes that alluvial deposits of tantalite and columbite are not at present of economic importance, but that the recent discovery, by Mr. Roberts of the Geological Survey Department, of a deposit of tantalite *in situ* has been more encouraging.

It was during May, 1939, that this deposit was located near the Jemubi river. The mineral occurs at the contact of a quartz vein with the underlying coarsely crystalline quartz-muscovite aggregate. This deposit is now being worked by the Bysia Syndicate. The tantalite here is of considerable interest in that it is of unusually high grade and equivalent to the best Australian material. Moreover, it is almost free from tin. A sample was received at the Imperial Institute where an analysis of picked specimens, separated as far as possible from adhering quartz, gave the following results: Ta_2O_5 83.39; Cb_2O_5 1.46; FeO 11.13; MnO 2.64; TiO_2 0.34; SnO_2 0.03; Total 98.99. The specific gravity was 7.78. Tantalum manufacturers require ore with a high tantalic oxide content (80 per cent. or more), coupled with not more than a few per cent. of columbic oxide and a low tin content; this requirement is well met in the above instance. It is also of interest to note that the Ta_2O_5 content of 83.39 per cent. closely approaches the theoretical maximum (86.1 per cent.).

An interesting mangano-tantalate of iron was discovered in concentrates from an alluvial gold-mine and later in its original pegmatite veins. Samples have been received at the Imperial Institute, and their precise nature is at present under investigation.

Export of Metals from Canada

Permits Rigidly Restricted

IN a written Parliamentary reply, amplifying a previous statement on the export of metals from Canada, Viscount Cranborne, Dominions Secretary, stated that no export permits had been granted for goods when there was any reason for believing that they would directly or indirectly fall into enemy hands. No permit had been granted for export of any product of which Empire and Allied supplies fell short of requirements. No scrap iron or steel had been exported from Canada since October, 1939, and no export from Canada, except to the United Kingdom, Allied countries, and the United States, of zinc and nickel since February, of aluminium since April, and of cobalt since August.

Shipments of other metals and minerals from Canada to destinations outside the Empire and the Western Hemisphere have been kept within the limits of normal peace-time trade with the other countries concerned. The copper position, in particular, had engaged the close attention of the competent authorities since the war began. About 80 per cent. of the output of Eastern Canadian producers goes under direct contract to the U.K. Ministry of Supply. The Metals Controller has made a new examination of the copper supply situation in relation to known U.K. needs, and the very considerable expansion anticipated in Canadian consumption when the fabricating plants now under construction are completed. It is now probable that all available Canadian copper will be needed to meet these demands.

Aluminium and its Alloys

Classified Summary of Specifications

TO meet a widely felt need, the technical staff of the Northern Aluminium Co., Ltd., has compiled a fully classified summary of current D.T.D. and B.S. Specifications relating to aluminium and aluminium alloy products. This publication should be useful to all engaged in working to light alloy specifications.

The number of such specifications is relatively large and the booklet, which is of a convenient size, has been compiled in order to provide ready reference by technical personnel in the numerous manufacturing concerns now working for the first time on light alloy materials to standard specifications.

The full range of British light alloys as specified at present is classified according to the various forms in which each is produced, namely, ingot, sheet and strip, bars and sections, tubes, wire and rivets, forgings and castings. The appropriate D.T.D. and B.S. Specifications are shown under each heading, with the proprietary nomenclature and tables of chemical composition and mechanical properties. A tabulated summary of proprietary alloys in alphabetical order, showing the corresponding specifications and the form of material to which they apply, is also given.

Copies of this publication may be obtained free of charge from the Research and Development Department of the Northern Aluminium Co., Ltd., Banbury, Oxon.

Tinning Developments

A New Sodium Cyanide Bath

IN the October issue of *Tin and its Uses* the International Tin Research and Development Council announces that its organisation at Fraser Road, Greenford, Middlesex, will now be known as the Tin Research Institute, direction and finance remaining unchanged. Copies of the magazine may be obtained free of charge from the Institute.

An article in this issue describes the properties of cold-reduced tinplate, and shows the advantages of the modern product over the old-style pack-rolled tinplate. Further information is given on the applications of electro-deposited tin coatings, which can be of any thickness desired. It is pointed out that articles of intricate shape can be plated in one process, and that electro-tinning is particularly useful for articles with soldered joints, which would disintegrate at the temperatures used in hot-tinning.

Protection Against Sulphur

For use with vegetable and meat contents a high degree of protection has been obtained against sulphur blackening, though the filmed surface has not proved immune to the attack of acid fruits. The plain cans are immersed in the filming bath for about five minutes at a temperature of 85-90° C. They are then removed and very thoroughly rinsed with water.

The composition of the bath is :—

Trisodium phosphate (crystalline)	40 g./litre
Sodium hexametaphosphate	20 g./litre
Sodium dichromate	12.5 g./litre
Sodium hydroxide	14 g./litre
Perminal KB	5 cc./litre

The last is a proprietary wetting agent obtainable from I.C.I. (Dyestuffs), Ltd., but other wetting agents which are stable towards caustic alkalis and chromates are also suitable.

The solution should preferably be contained in an enamelled tank, but a plain, mild-steel tank may be used provided that the cans do not come into contact with the steel. If possible, softened water should be used in making up the solution. The wetting agent will not dissolve properly in the cold, but dissolves on heating. The *p*H of the bath must be maintained at 12.5, and although the process consumes a negligible amount of the chemicals, small adjustments have to be made from time to time.

Photographs illustrating the article reveal that the untreated cans show considerable staining, but the treated cans appear as bright as when originally packed.

A new method for tinning copper or brass by a simple chemical process is also described in this issue. The new bath produces uniform adherent tin coatings on copper, red and yellow brasses, commercial copper-tin alloys, and bronzes containing small percentages of aluminium or other alloying elements. Other materials, such as iron or steel, can be tinned by this immersion process if they are first coated with copper or brass. The method is easily applied to articles of intricate shape, or to the insides of pipes and even coiled tubing.

The composition of the bath is as follows :—

Sodium cyanide, NaCN	50 grams per litre
Stannous chloride, $SnCl_2.2H_2O$	5 ,, ,, ,,
Caustic soda, NaOH	5.6 ,, ,, ,,

The solution is easily prepared by adding the caustic soda slowly and with agitation to an aqueous solution of stannous chloride; after adding the sodium cyanide and diluting to the required volume the bath is ready for use. The article to be tinned must be thoroughly cleansed of all grease and dirt. This process can be applied to a wide range of uses where a relatively thin coating of tin is required, to improve the appearance and corrosion resistance of copper or brass articles. Water is often discoloured by dissolution of metal from new copper pipes, until a deposit of calcium salts has had time to accumulate. The colour is detectable at 2 parts of copper per million, and the green stain is accentuated by soaps. Tests showed that excellent protection was given to copper and brass pipes by a coating of tin. The protection afforded by this type of coating would also appear to be adequate for tinning copper wire to be used with rubber insulation. The process is recommended for its simplicity. A wooden or steel tank is all the equipment required, and the bath is extremely economical in operation.

South Australian Metals

Copper and Manganese Development

THE Mining Review of the Department of Mines of South Australia for the half-year ended December 31, 1939, states that the total value of mineral products for the full year totalled £3,357,103, a figure much higher than previously recorded for any single year. The previous record figure was in 1938, when the value amounted to only £2,958,457. Iron ore, as in all previous years, was the chief contributor to the total, its value amounting to 87 per cent. of all minerals mined.

Regarding the question of state assistance to the copper mining industry and the suggestions that have been put forward that some of the older copper mines that were highly productive in the past should be reopened by the state, the report states that these questions have been considered by the government, and that "although there is no intention whatever to undertake copper mining as a purely state enterprise or to work any mine wholly by the government with funds provided by the general body of taxpayers, it is desired to help copper mining in any part of the state in the same manner as is followed in the case of any other industrial enterprise, in accordance with the policy of the government. The assistance will take the form of financial help towards development work—shaft sinking, crosscutting and driving on lodes—that is absolutely necessary for the mine to enter upon reasonably continuous production. It is considered that no lasting good can result from the premature erection of treatment plants of any kind." Funds are still available for development work which have been contributed equally by the Commonwealth government and the state governments to assist metalliferous mining under certain conditions which have been accepted jointly by the two governments.

Ferro-Manganese Production

Dealing with manganese ore production, the report states that the decision of the Broken Hill Pty. Co., Ltd., to manufacture ferro-manganese in Australia has created a domestic market for the high-grade ore which that state is able to produce. The deposits situated at Pernatty Lagoon are now being worked on a fairly large scale to satisfy this demand, the ore being shipped to New South Wales from Port Augusta. Prospecting for other deposits is in active progress. No less than 95 per cent. of the manganese produced, according to the report, is consumed in the manufacture of steel, the balance being used in the manufacture of dry batteries, in glass-making, where manganese compounds correct the greenish colour due to iron, in the preparation of certain types of glazes and coloured tiles, bricks and enamels, in certain oils used in pigments and in the body of certain pigments, in the manufacture of chlorine, and, in combination with potash and oxygen as an oxidising agent, in agriculture to remedy soil deficiencies and in various other ways. The deposits of manganese are distributed widely if irregularly throughout the world, and there is much international traffic in these ores, the destinations being naturally the steel-producing centres. The eastern portion of the United States is supplied with manganese ore from many countries. The ruling prices per ton are not high, and it follows that geographical position is all-important in deciding whether or not a deposit can be worked profitably.

Copper Alloys in Oil Refining*

Varied Properties of Different Types

OIL refiners use copper alloys for tubes and tube sheets in heat exchangers and condensers; for baffle and turbulence plates; for pipe for conveying dilute acid and the residues from acid treatments; for water-supply systems; for strong corrosion-resistant bolts, screws, and fastenings; for parts of machinery, electrical equipment, and many other purposes, including protective linings. Certain limitations must be observed as to temperatures and stressing—limits that in many cases are substantially lower than those observed with steel or the high-nickel alloys.

Half-a-dozen copper alloys are in use for condenser and heat-exchanger tubes. The choice must be made with consideration of the gas and oil streams to be handled or the cooling water used. Generally speaking, little oil-side corrosion is experienced in exchangers heating still feeds, and not much on the other side from run-of-refinery overhead. Wear and tear in condensers is much more common, and is heaviest on the vapour side in those temperature ranges in which steam condensation occurs and water accumulates on the tubes. The severity of attack depends on the crudes, under- or over-treatment of the vapours with neutralisers, construction of the bundle, flow of gas over the tubes, drainage, cleanliness, constancy of cooling-water supply, etc. Subcoolers or after-coolers, if used, may or may not be troublesome. Usually the condensate causes little difficulty with brass tubes in submerged condensers. Brass tubes in exchangers on stabilisers, or in shell and tube equipment handling the fixed gases, rarely are corroded to failure by the gas stream. Cooling water is a refinery problem everywhere; the condensers are one of the sensitive spots. Water causes as much tube destruction as the condensing vapours.

Among the cupro-nickel alloys the 30 per cent. super-nickel has found greatest favour for "hot spots" and emergency repairs, when doubt has been cast on the serviceability of the more usual tubes. The choice has been made often without a trial of the 20 per cent. nickel types, merely on the ground that if a cupro-nickel is good, the one with the most nickel must be best. Probably there are many places where the lower-nickel tubes can be used to advantage. We also may expect greater interest in them in the future.

Admiralty Brass

Admiralty brass condenser tubes have such well-balanced properties that they are used in very many refineries, though they are less durable than aluminium brass when used with salt water under the temperature, pressure, and flow conditions existing in steam-power condensers. The reasons why an alloy of just the proportions of admiralty brass—70 per cent. copper, 29 per cent. zinc, and 1 per cent. tin—should be of so much more general serviceability than others, are not certain, but it can be observed that there has been no substantial change in the composition through all these years of question and experiment. There is an accepted belief that the 29 odd per cent. of zinc with tin affords a better measure of resistance to sulphide-chloride corrosion on the gas stream and oil side than lesser percentages—that it strikes a fair middle of corrosion resistance on the water side. The weaknesses of admiralty are those of all the brasses of its type, a susceptibility to dezincification and to an intercrystalline type of cracking caused by ammonia or other reagent. Several remedies for dezincification have been proposed and used. A selected fourth alloying element can be introduced. Arsenic has been used for this purpose since 1933. More recently antimony and phosphorus have been suggested as accomplishing the same ends. The true value of each of these will appear as experience is gained in actual service. Intercrystalline cracking is a subtle phenomenon often caused by unsuspected forces that may originate in bundle assembly, temperature differentials, lack of mechanical freedom of the floating ends, and from poor rolling. It is a very infrequent type of failure, and one that at times has been stated to have been associated with the presence of addition elements such as arsenic, though without sufficient evidence. Corrosion cracking is found, although rarely, even in deoxidised copper, and in many metals and alloys containing no copper.

Brass tube sheets for condensers and exchangers most often are of Muntz metal (60 per cent. copper, 40 per cent. zinc), although naval brass frequently is preferred at a slightly greater cost for its better durability. Muntz and common or yellow brass are favoured about equally for baffles and turbulence plates in exchanger bundles.

Red brass is the common non-ferrous pipe for handling dilute sulphuric-acid washes and the residues from the acid treatments of gasoline and lubricating oils. The heater and agitating coils in acid-treating vessels are often of red brass in the heavy and extra-heavy standard pipe sizes trimmed with cast "acid-bronze" fittings.

Everdur

Everdur, the copper-silicon-manganese alloy, is used for separation and settling tanks, and for pipe in equipment for rapid and desulphurising treatment of gasoline by sulphuric acid. These alloys have been adopted widely for corrosion-resistant bolts, nuts, and screws. Because of their better strengths and freedom from dezincification these alloys have replaced Muntz, naval brass, and common brass bolts in submerged condensers. Wood screws, bolts, and tie rods made of them are excellent fastenings for spray cooling towers. A further extension of Everdur into the field of tank and vessel linings may be expected in the course of time, probably first as a stronger and weldable substitute for lead in acid treaters.

A great deal of research and development work has been done by the brass makers in their own plants and laboratories, but not much of it has had direct bearing on the problems of oil refining. Many metal manufacturers are helpful, however, in advising and supplying material to refiners who do research work of their own, and in opening laboratories for inspections that cannot be made conveniently elsewhere. The results of the work on elevated-temperature testing, on creep, and on exposure to steam, natural waters, the atmosphere, etc.—which work is now under way—will be available in due course, and will be applied to the advantage of refineries as well as to other industrial users of non-ferrous metals.

* Abridged from a Paper by J. T. Kemp, American Brass Co., presented at the mid-year meeting of the American Petroleum Institute; reprinted in Can. Chem. & Proc. Ind., 1940, *24*, 9, pp. 444-6.

BELGOMETAL S.A.

Particulars of the **Belgometal Société Anonyme** (Belgian Commercial and Metallurgical Co.), originally registered in Brussels on December 24, 1932, have been filed (No. F3601), pursuant to Section 344 of the Companies Act, 1929. The original capital was 500,000 francs in 500 shares of 1000 francs each. The capital has been increased by various stages (last increase in October, 1939) to 3,500,000 francs in 1000 franc shares. The objects are to deal in crude and old metals and in ores and chemicals; to carry on demolition and other undertakings and all commercial, industrial and financial operations, etc.

The British address is Palmerston House, Bishopsgate, London, E.C.2, where Samuel Arnold (director and general manager) and Leman Arnold, of 45 Hodford Road, London, N.W.11 (manager) are authorised to accept service of process and notices on behalf of the company. The directors are: William Verstraete (present address unknown); Samuel Arnold, "The Laurels," Rathgar Close, Dollis Avenue, London, N.3; Alphonse Verstraete; Hubert Delacollette; and Edouard Louette (present address of these three unknown). (S. Arnold is Dutch and the others are Belgian.)

The original constitution of the company provided that the head office was to be in Brussels but that in the case of a war in Belgium such office might be transferred temporarily to a foreign country by board resolution.

General News——From Week to Week

THE AGE OF RESERVATION of research workers is raised from 25 to 30 from November 1.

AS A START TO the Edinburgh War Weapons Week, which opens on November 4, the Distillers Company, Ltd., have promised a contribution of £1,000,000.

SUFFERING FROM SEVERE BURNS, Frederick Morley (27), of Lambert Street, Stockton, was detained in Stockton and Thornaby Hospital recently. He was involved in an accident at a Stockton works, and it is stated that he fell into a tank containing a solution of acid.

THE FOLLOWING FELLOWS have been elected by the Board of the Institute of Physics: J. S. Forrest, M.A., B.Sc.; A. R. Hogg, M.Sc. F. L. Jones, M.A., D.Phil.; and I. C. Jones, M.Sc. Eight associates, seventeen students, and three subscribers were also admitted.

TWELVE PEOPLE LOST THEIR LIVES, six being buried under debris and the others dying subsequently in hospital, as a result of an explosion and fire which wrecked the large starch works of James A. Morrice (James Anderson and Co., Ltd.), in the centre of Glasgow on October 24. Nearly thirty other workers were injured. The cause of the explosion, which apparently occurred in a boiler house, is unknown.

THE BOARD OF TRADE ANNOUNCES that, for the date October 30, 1940, being the date before which returns under the Limitation of Supplies (Miscellaneous) Order were required to be sent to the Assistant Secretary, Industrial Supplies (Registers) Department, Board of Trade, Fanum House, Whitcomb Street, London, W.C.2, there shall be substituted the date November 25, 1940.

THE SEPTEMBER-OCTOBER NUMBER of *The Nickel Bulletin* deals notably with Age-Hardening Alloys and contains machinability-rating charts and tables of the thermal conductivity of the various cast irons and steels. Among pamphlets, etc., reviewed are those dealing with Nickel Alloys in Oil- and Gas-Pressure Controls and Nickel Equipment Used in the Production of High-Purity Caustics.

DETAILS OF A PROCESS for manufacturing a new type of rayon will be given by Professor J. B. Speakman, head of the Department of Textile Industries of Leeds University, in a lecture to the West Riding section of the Society of Dyers and Colourists in Bradford on November 14. The fibre, one of the main characteristics of which is said to be non-inflammability, has been developed by Professor Speakman in conjunction with a firm whose identity remains undisclosed at present.

ACCORDING TO THE BOARD OF TRADE RETURNS for September, 1940, imports of chemical, drugs, dyes and colours into the United Kingdom were valued at £1,170,142, an increase of £187,127 compared with the figure for September, 1939. Exports were valued at £1,726,474, an increase of £1,002,818, while re-exports, at £39,270, showed an increase of £3388. For the eight months to September 30, imports increased in value by £2,107,980 to £14,119,311, and exports by £6,182,589 to £23,223,275. With this last figure the chemical trade maintains its pre-eminent position in the export drive among the 21 groups of articles wholly or mainly manufactured, as listed by the Board of Trade.

Foreign News

THE MONTHLY CONSUMPTION of iodine, crude and refined, in Belgium, has been restricted to 30 per cent. of the average quantity used during the quarter ended March 31, 1940.

THE ESTABLISHMENT IN BELGIUM of new factories to manufacture soap or other cleansing materials is prohibited by decree. Raw material shortage is the alleged cause for this prohibition, but factories in existence on June 1 are allowed to carry on.

A PILOT PLANT for the production of ethylene dibromide, to be used in conjunction with tetraethyl lead as an anti-knock agent, has been erected in Japan by the Dai Nippon Salt Industrial Company.

CONSTRUCTION OF THE FIRST FACTORY for the production of plastics from Brazilian coffee has begun in the state of S. Paulo, Brazil. The Departamento Nacional do Café has installed, in Rio de Janeiro, a modern laboratory for research into the chemistry of coffee, and the plastics will be produced under an agreement between the Departamento and certain United States interests.

DURING JUNE 207,495 cwt. of manganese oxide, valued at $105,618, were imported into Canada, compared with 72,613 cwt., worth $48,196, in June, 1939. The Gold Coast supplied over three-quarters of the total.

A RADIO REPORT FROM SYDNEY, quoted by Reuter, announces the formation of a £500,000 company in Tasmania to manufacture magnesium. It is stated that a mining programme of 10,000 tons of ore per annum, enough to yield 1000 tons of magnesium metal, is envisaged.

ONE UNIT OF A PLANT of the General Petroleum Co. at Torrance, California, was destroyed at the beginning of last week by an explosion and fire of unknown origin. The fire blazed for an hour before being controlled, but the large gasoline tanks were saved.

AN AMERICAN COMPANY is now marketing a cream, known as Ply No. 8, that is claimed to furnish protection against burns to welders and cutters. It is applied like ordinary cold cream and rubbed into the skin till completely dry. Its ingredients are stated to block the ultra-violet and infra-red rays which come from the flashes during welding operations.

WHILE THE LARGEST LINSEED ACREAGE for over eight years was planted in Argentina during the current crop year, production of linseed, according to the latest reports, will be the smallest registered for ten years, owing to bad weather conditions last April and May, as well as to lower yields on account of impoverished soil and disease.

ACCORDING TO REPORTS from Japan, one of the laboratories of the Mitsui Mining Co. has manufactured a rubber compound from coal. It is stated that "the Mitsui rubber compound is obtained after applying a special chemical process, resulting in a synthetic rubber that is claimed to be strong and durable." The New York office of the Mitsui interests does not place too much credence on the reports.

A PROGRAMME FOR CONVERTING surplus potatoes of the 1940 crop into starch and dextrine is announced by the Surplus Marketing Administration of the U.S. Department of Agriculture. Under the programme, operating mostly in the state of Maine, where practically all the potato starch of the country is normally produced, an estimated 45,135,000 bushels will be produced, an increase of 6,885,000 bushels over 1939.

THE CHANGING FORTUNES of the shipment from Mexico to Japan of 700 flasks of mercury, 2000 tons of fluorspar, 5000 drums of gas oil, 14 sacks of molybdenum concentrates, five tons of scrap nickel, four tons of lead, two car-loads of electrolytic copper, and five tons of mica, are continually in the news. The latest report of *The Times*' Mexico correspondent is that the goods will be despatched on November 15 from Manzanillo, the embargo having been raised for the moment. United States commercial diplomacy, aiming at American continental solidarity, may have another word to say in the matter.

Forthcoming Events

AT THE MEETING of the Institution of Civil Engineers on November 5 at Great George Street, London, S.W.1, Sir Leopold H. Savile, K.C.B., will deliver the presidential address at 1.30 p.m.

A MEETING of the Food Group of the Society of Chemical Industry will be held in the Hall, British Medical Association House, Tavistock Square, W.C.1, at 11 a.m. on November 13. The subject is "The Potato as Food." The chairman will be Monsieur André Simon, and papers will be presented by Dr. R. N. Salaman, on "The Biology of the Potato," by Dr. L. H. Lampitt and Mr. N. Goldenberg, on "The Composition of the Potato"; and by Dr. Harriette Chick, on "The Nutritive Value of the Potato."

A MEETING OF THE CHEMICAL SOCIETY in Glasgow has been arranged for November 15, when Dr. W. T. Astbury will read a paper on "The Structure of Proteins" in the Royal Technical College at 7 p.m.

THE INAUGURAL MEETING of the British Rheologists' Club will be held in the morning of November 16 at the National Institute for Research in Dairying, Shinfield, Reading. The subject of the paper is not yet selected, but it will be followed by a discussion and luncheon. In the afternoon rheological apparatus used in the dairying industry will be inspected.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

MURRAY (SCIENTIFIC INSTRUMENTS), LTD., Liverpool. (M., 2/11/40.) October 1, debenture to Barclays Bank Ltd., securing all moneys due or to become due to the Bank: general charge.

R. E. THOMPSON & CO. (SUNBURY), LTD., Sunbury-on-Thames, instrument makers. (M., 2/11/40.) October 11, charge, to Barclays Bank Ltd., securing all moneys due or to become due to the Bank; charged on Albert Works, Avenue-road, Hampton.

County Court Judgments

MOORE MEDICINAL PRODUCTS, LTD. R.O., 3/5 Burlington Gardens, W.1., manufacturing chemists. (C.C.J., 2/11/40.) £15 4s. 6d. September 4.

Companies Winding-Up Voluntarily

MODERN PAINTS AND FINISHES, LTD. (C.W.U.V., 2/11/40.) Creditors of the company are required to send claims to Richard A. Witty, 7 Union Court, Old Broad Street, London, E.C.2., by November 30.

FLINTSHIRE REFRACTORY CEMENTS, LTD. (C.W.U.V., 2/11/40.) Meeting of members at the offices of General Refractories Limited, Genefax House, Sheffield 10, on Saturday, November 23, at 10.15 a.m.

Chemical Trade Inquiries

British India.—An agent established at Karachi wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of chemicals and pharmaceutical specialities for the North-West Frontier Provinces, and the Punjab, including Delhi, Kashmir, Sind, and Baluchistan. (Ref. No. 501.)

Brazil.—An agent established at Florianopolis, Santa Catharina, wishes to obtain the representation of United Kingdom manufacturers of machinery, lead or white zinc paint, and chemical products used in industry, such as caustic soda, among other articles. (Ref. No. 514.)

United States of America.—An agent established at Los Angeles wishes to obtain the representation of U.K. manufacturers of industrial chemicals. (Ref. No. 536.)

Company News

The Rio Tinto Co., Ltd., announces a dividend of 2½ per cent. for the past half year on the 5 per cent. cumulative preference shares. No dividend has been paid on the ordinary shares since 1930.

Sternol, Ltd., announce six months' dividend on the 8 per cent. cumulative participating preferred ordinary shares, bringing payments up to December 31, 1935.

The United Steel Companies, Ltd., have declared a final dividend of 5½ per cent., making a total distribution for the year of 8 per cent., less tax.

Midland Tar Distillers, Ltd., announce a trading profit for the year ended June 30 of £92,916 (£59,858). An ordinary dividend of 5 per cent. for the year is being declared. Meeting, Oldbury, November 7, at 2.30 p.m.

Murex, Ltd., report a new high record in the trading profit for the year to June 30 last, which amounts to £490,440 (last year £267,562). Meeting at Winchester House, London, E.C., on November 4, at noon.

Shawinigan Power and Water Co., the organisation controlling Shawinigan Chemicals, Ltd., has declared a dividend of $0.22 on common stock for the quarter ended September 30, payable November 25.

Allied Colloids (Bradford), Ltd., 260 Swan Arcade, Bradford, have increased their nominal capital by the addition of £2000, in 6 per cent. cumulative preference shares of £1 each, beyond the registered capital of £5000.

William Neill and Son (St. Helens), Ltd., announce a net profit of £21,757 for the year ended March 31 last (last year £26,199). The final dividend is 8¾ per cent., again making 20 5/6 per cent. for the year. The profit is arrived at after charging £70,391 for taxation (last year (£15,755). Meeting, November 6.

Lever Brothers and Unilever, Ltd., are paying no interim dividend this year. Last year there was an interim of 4¾ per cent., followed by a final of 5½ per cent. A statement issued by the company, however, announces that "according to the most recent indications, the profits for the current year, after making the necessary reserve for taxation, should not differ materially from those of 1939."

New Companies Registered

British Cellulose Industries, Ltd. (363,656).—Private company. Nominal capital: £500 in 500 shares of £1 each.—Manufacturers of and wholesale and retail dealers in cellulose, paints, varnish, enamel, lacquer, polish, shellac, size, pigments, compositions, wax and other articles, manufacturing chemists, paint spraying contractors, etc. Directors are: Raymond G. Kennedy, Harold E. Lockyear. Registered office: Ethylex Works, Renshaw Street, Manchester 15.

Chemical and Allied Stocks and Shares

THE extension of the war to the Balkans was followed by moderate marking down of security values on the Stock Exchange. This was mainly a precautionary measure, and steadier conditions developed when it was clear that no heavy selling pressure was likely to be experienced. Sentiment in regard to industrial securities continued to be assisted by the hopes attaching to the coming Government proposals for insurance of property against air-raid damage; while elsewhere there was steady demand for British Funds and other leading investment stocks, although on balance, prices were slightly easier in accordance with the prevailing tendency in the stock and share markets.

Among chemical and kindred shares, Imperial Chemical were little changed at 27s. 3d. while the preference units were rather more active and higher at 30s. Business in B. Laporte again took place around 50s. and Goodlass Wall ordinary at 8s. 6d. held their recent improvement, while Borax Consolidated deferred remained at 25s. 7½d. On the other hand, Lever & Unilever reacted from 25s. to 23s. 9d. on the decision not to pay an interim dividend, which, judging from the official statement, is due to the uncertainties of general conditions and not to any falling off in earning power. British Match were firm, and in other directions, British Oxygen, British Aluminium, Murex and Cerebos were relatively steady, despite the easier trend on the Stock Exchange. Turner & Newall held their recent rally to 63s. 1½d. and the general tendency in shares of companies associated with the building trades was again satisfactory, with Associated Cement 60s. 7½d. and British Plaster Board 11s. 9d. Wall Paper deferred units were again 17s. 6d. Pinchin Johnson were around 18s. on further consideration of the statement which accompanied the interim dividend decision.

British Glues & Chemicals 4s. shares were quoted around 5s. 6d. and the participating preference shares transferred at 26s. at one time. United Glass Bottle were 44s. 6d. and Triplex Glass 18s. 9d., while Canning Town Glass 5s. shares were around par. Dealings in Morgan Crucible second preference units took place at 18s. 6d., and in Sanitas Trust ordinary at 12s. 6d., while British Drug Houses preference have transferred at 20s. 9d. In the iron and steel section, Stewarts & Lloyds were firm at 39s. 6d.; Tube Investments were steady at 82s. 6d., having remained under the influence of the maintained dividend. More hopeful views in regard to the forthcoming dividend of Dorman Long drew some attention to the shares of this company, which have a slightly more active appearance at 21s. 3d. Consett Iron, however, were easier at 6s. 1½d. Sentiment in regard to textile shares continued to be affected by uncertainties as to the full effects of the purchase tax, and Courtaulds were 28s. 4½d., while British Celanese second preference were 9s. 6d. Dunlop Rubber were 30s. having regained part of an earlier small decline. Imperial Smelting, however, developed an easier tendency at around 9s. 6d. Fison Packard remained around 28s. awaiting publication of the financial results.

Boots Drug were steady at 40s.: the firmness of these 5s. shares is due to market expectations that earnings will continue to run at a good level and permit the maintenance of the dividend and annual cash bonus. Timothy Whites were 18s., while Beechams Pills deferred were quoted at 8s. 6d. The ordinary units of the Distillers Co. were very firm at the slightly better price of 57s. 6d. and United Molasses also had a firm appearance. Among oil shares movements on balance were adverse to holders, but little selling was reported, the absence of an interim dividend on Anglo-Iranian units being in accordance with general expectations.